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FMEA (FAILURE MODE AND EFFECTS ANALYSIS) AND PROPOSAL OF RISK MINIMIZING IN STORAGE PROCESSES FOR AUTOMOTIVE CLIENT

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Abstract: There are several quality tools that support achievement of goals and ensure primary basis for promoting quality in enterprises. FMEA is a quantitative inductive method, which was created for the recognizing and evaluating of products and processes failures, with considering that risks are categorized according selected criterias. Identifying and removing risks prevents the formation of dangerous consequences. It is possible to define any eventual system failure by the method reviewing. The documentation process is a key activity in addressing of structural changes FMEA. In automotive industry is requested to observe quality, production and marketing standards on high levels which contain more specialized norms and certificated programs as well. The articel is focused on risks minimizing in goods and orders receipt and goods outgoing.

1 Introduction

It has been long known that logistics is not just a matter of one class and one process. Logistics covers all industries and processes in which come to organization, secure and management of material, information and financial flow. The largest rate of Slovak industry is in automotive, up to 44%, and at the same time is Slovak republic leader in number of produced automobiles per 1000 inhabitants, up to 184pcs [1]. Acceleration in automotive industry does not accelerating legislative only, but social changes and challenges in automotive supply chain as well. Necessity of reviewing tool FMEA, and proof of detection risks in company members of the automotive supply chain is implemented in programs of customer audits, automotive standards and controlling processes.

Maintenance terminology according to EN 13306 defines the fault as the termination of the ability of required function in object performation. Elimination of defects and repair times shortening is a challenge for every business in every time. By minimizing of defects is necessary to take into account the severity and consequences of the defect management system. Failure management solutions should not allow the liquidating.

The process as defined by portal Business Dictionary is a sequence of interdependent and linked procedures which at every stage consume one or more resources (employee, time, energy, machine, money) to convert inputs (data, material, parts, etc.) into outputs. These outputs then serve as inputs for next stage until a known goal or end result is reached.

Storage is a process which main task is to placement material goods, products, raw materials on time and at the same time prepare the transport units according to customer requirements, production and transport possibilities in order to ensure continuity of material flows, to satisfy the demands of the market and the effectiviness of follow-up activities, such as loading, unloading, transport, distribution and preparation of the accompanying documents. Other reasons include storage buffer feature that compensates the various material flow and material requirements in quantitative and timing terms. Storage also provides coverage to the fluctuating needs of sales and supply markets, fulfills the function of speculation arising from the expected growth of prices on the market and make a wide range according to the needs of individual plants, so-called a completion function. The qualitative changes in the product range storage (drying, aging, fermentation, etc.) performs a processing function but there would be a so-called. productive stores.

2 FMEA

FMEA history dates to seventies of the 20th century, when the National Aeronautics and Space Administration (NASA) has brought investigative solution to determine the reliability of the system FMEA for the project Apollo. In August 1966 was created a document with 4 chapters, which defines detailed description of the mission and methods of the FMEA toll for this project. In addition, are included the critical groups of possible errors and their consequences. The most serious consequece of the error in the above-mentioned document is considered the death of the spacecraft crew. The model of FMEA is with small modifications used until today.

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In the 80s, the procedure started to be implemented FMEA in the automotive and later the nuclear industry. In Europe began with the implementation Ford as first, then Volkswagen. FMEA is currently ranked the most common used methods for assessment and evaluation of the potential risks. Tool FMEA can be applied to the process or the system, but some authors divide it also to software FMEA or design FMEA.

Process FMEA analyzes errors during manufacturing, installation, storage or other activities. In this case is by solving used the system approach. Here are analyzed errors, which are generated in the process, their mutual relations and errors entering and releasing the process. Errors and effects are ranked according to their risk and on the basis of the proposed actions to eliminate risks. Attention is focused on the suitability and safety of processes to ensure the quality and stability of the process.

System FMEA aims eliminates system errors by system designing. Analysis of system is mainly used in pre-production, run-in phases and with participants from all business units. Figure 1 shows the flow of information in the FMEA performing by Ford Handbook, which is available for its suppliers. The downward arrows represent the main stream (material, information, financial), and the upward arrows represent feedback for learned lessons. Double-sided arrow points to the interface between the FMEA and addressing the massive problem. FMEA and REDPEPR (Robustness Engineering Design and Product Enhancement Process) complement each other.

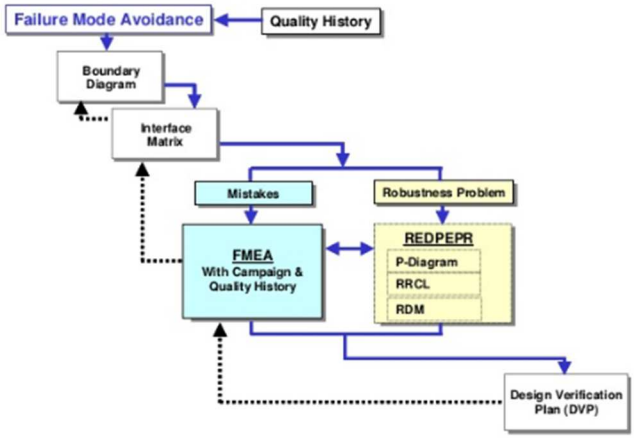

Figure 1 Information flow according Handbook Ford

Brainstorming is a key method by generating the FMEA ideas. This method promotes the creativity of the authors, allows the relaxed atmosphere and mutual inspiration in presenting proposals.

Ishikawa diagram, known as Fishbone diagram, is used to display the problems and possible causes. The main axis is a problem and the branches of the main axis are the effects that are caused of the problem. At the beginning of diagramming it is necessary that the investigators define the main possible causes of the problem (material, equipment, methods, people, nature etc.)

Pareto diagram (Figure 2) is by FMEA next significant analytical tool, that is able to identify the most important issues of the criteria. Here is applied the Pareto Principle 80/20 and to the most important issues shoud be given the most attention.

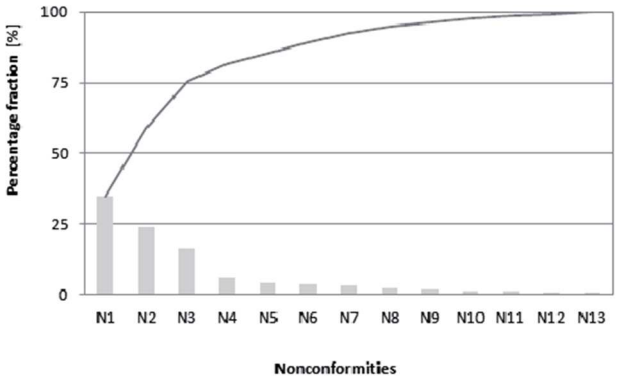

Figure 2 Pareto diagram

To use the full potencial of this method and achievig the main goal, it is necessary to identify potencial risks even before the process fails. Time, capacity and finance used in the correct reviewing of the FMEA by changing the product/ process are inversely proportional to the time, capacity and finance consumed by dealing already produced undesirable consequences.

As was mentioned above, FMEA is quantitative method as the numerical evaluation of the risk level (1) is described as the product of probability (frequency) of the negative effects occurance and consequence of the fault, i.e.:

$$R = P \; x \; D \qquad (1)$$

where R is a measure of risk, P is the probability of risks and D is the result of risk.

The risk influences of the system are mostly categorized according to the severity, safety features, environmental aspects and the duration of the idle period. An example of FMEA header is in Figure 3 and an example for ranking of severtiy criteria is in Table 1.

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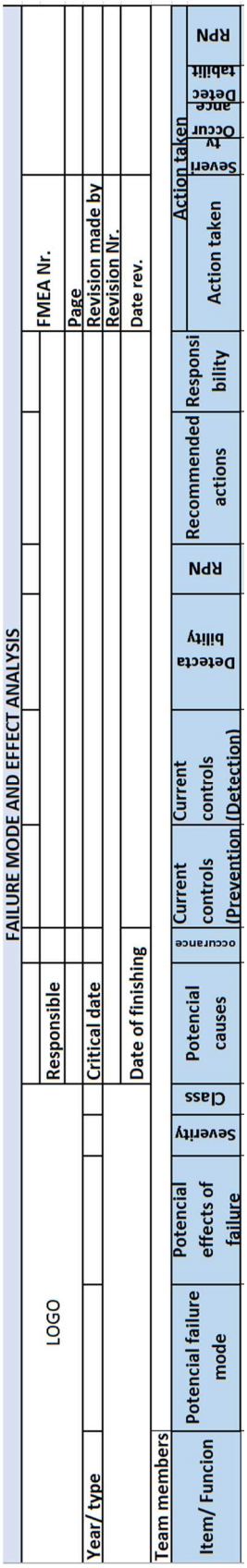

Figure 3 FMEA header

Table 1 Ranking of severity effect

Ranking	Effect	Criteria: Severity of Effect
1	None	No effect
2	Very Minor	Very minor effect on product or system performance.
3	Minor	Minor effect on product or system performance.
4	Low	Small effect on product performance. The product does not require repair.
5	Moderate	Moderate effect on product performance. The product requires repair.
6	Significant	Product performance is degraded. Comfort or convenience functions may not operate.
7	Major	Product performance is severely affected but functions. The system may not be operable.
8	Extreme	Product is inoperable with loss of primary function. The system is inoperable.
9	Serious	Failure involves hazardous outcomes and / or noncompliance with govt. regulations or standards.
10	Hazardous	Failure is hazardous, and occurs without warning. It suspends operation of the system an/or involves noncompliance with govt. regulations

Using of FMEA tool is supported by many quality standards which are worlwide valid as QS 9000, ISO TS 16949, or regional certification standards which are valid for specialized country areas, as VDA, AVSQ or EAQF. Figure 4 is describing the main focus of each mentioned norm.

Figure 4 Certification programms

3 Minimizing of failure in storage processes

In terms of storage is clear that stocks must be strictly controlled and careful monitored by physical inventories in warehouse and supported by additional processes in storage process, like appropriate storage methods, technical equipment, time management of loadings and unloadings, which are secured by appropriate information flow in standard documents forms. In the case, that stocks are not accurate, it may brings the following consequences like unwilling stockpilling, frequent ordering, when the actuall stocks are not visible for users, ineffective inventory systems, direct shopping, incorrect records, errors in input data, loss of documents, loads without proofs, discrepancies between the physical and system state, unrecorded decifit, incorrect placement, packaging, labeling, etc. Finally, all nonconformities cases the failures in customer satisfaction.

To avoid the most possible amounts of failures in the storage processes is requested to revaluate the actuall performance of processes. Preparing supportive actions for optimization of storage locations, warehouse zoning, processes for inventory performance, goods segmentation, container management, written solutions for most common system problems and motivation programs for staffs are elementary activities that support the applicable storage actions and processes.

Conclusions

From the indicators in warehouse logistics can be said, that the apllication of FMEA brings the optimizing of the parameters of productivity, efficiency and also advantages to the structural indicators. As reported by Carlson, consultant and instructor for FMEA methodology, FMEA provides effective solutions for eliminating the risk occurance by using the optimizing the storage space by 30%, then brings advantages in work load of warehouse equipment by 7% and increase the productivity of employees by 25%. This means in praxis, less demands for storage spaces, less warehouse equipment and decreases in human resources working on the processes, which are evaluated by tool FMEA.

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